Water Distribution

Teacher Overview

📖 Grade Level: 6-8

📖 Subject Areas:
Earth Science (geology, hydrology, meteorology, topographic mapping and soil science)
Math
Physical Science

📖 Duration:
a. Integrated teams could complete this spoke within a week.
b. If this study is scheduled for one week within individual classrooms, the students could be divided into groups who concentrate on different Big Ideas (Structure, Energy, Environmental Interaction, and Human Presence). Groups could then give reports to the rest of the class as well as share data with San Antonio Missions National Historical Park. If the entire class did all Big Ideas, the time needed would be increased by at least 7 days, due to increased time for pre-visit activities and post-visit activities.

📖 Setting:
Classroom, Outdoor area on campus, Mission San José, Espada Aqueduct, San Juan, Labores

📖 Essential Terms:
(See individual units.)

A Unit Overview

Background

The San Antonio missions were established along the mainly spring-fed San Antonio River (Indian name, *Yanaguana*). Both early Indians and later the Spanish missionaries were influenced in their choice of settlement by this source of water. The river flowed even during dry times due to springs.

The suitability of the land near the San Antonio River for farming was another incentive for the location of the missions. The average annual precipitation is 31 inches (range 10-58 inches). Crops needed to be irrigated in order to ensure sufficent supplies for all the inhabitants of the missions.

During years with abundant rainfall, the banks of the river were subject to flooding. Some missions were forced to relocated out of the flood plain of the San Antonio River.

Centuries earlier, the Spanish had learned from the Moors how to irrigate using gravity-fed *acequias* (irrigation ditches). An *acequia*, 4 feet deep and 4-5 feet wide, began several miles upstream from each mission and its *labores* (farm fields). Immediately downstream from where the entrance of the *acequia* was to begin, a *presa* (dam) was built. The dam raised the water level high enough so water would enter the irrigation ditch.

The *acequia* followed the natural contours of the land. The slope of the *acequia* needed to be steep enough so the water would not stagnate, but gentle enough so its water flow would not cause constant erosion. Increasing the slope of the *acequia* increased the force of gravity on the water and therefore increased the velocity. Friction of the water against the bottom

material decreased the velocity. Both the force of gravity and the force of friction affected the velocity and total discharge of the water.

The amount of land given to a Spanish family was determined by the amount of water needed to irrigate it in a given time. When the water reached the labores, the ditch master opened a gate, allowing a specific amount of water to flow into a specific area for a specific amount of time.

The earthen bottom of the *acequia* and soil of the labores allowed water to be absorbed in places and still flow in the *acequia*. The texture, porosity, and permeability of the soil were important. These can be easily measured in the Mission San Juan *labores*.

About 1794 when wheat became accepted as part of the local native diet, the missionaries harnessed the energy of the *acequia's* water to power a gristmill at Mission San José.

Making Connections

Students will:

- Investigate the way people living in the San Antonio missions used and distributed water by collecting data at the missions.
- Use topographic maps and conduct field investigations to better understand the structure of the *acequia* and the effect of gravity.
- Gather data concerning slope of the land, velocity and volume discharge of water flow in the *acequia*, soil characteristics of the bottom of the *acequia* and the *labores*, water pressure in the mill containment area, and the mechanical advantage of the mill.
- Gather the data before the trip, record their data at the missions, and conduct further investigations after the visit to interpret the data.
- Share the data with other students 1) by recording the data at San Antonio Missions National Historical Park, and 2) by presenting their data to the class.

Teacher: Read each of the following plans and choose one appropriate for your class.

Plan 1: All teams will work on the Pre-visit and the Structure Big Idea activity with the topographic map. Teams will collect data for different Big Ideas during the mission visit. All teams will visit the same areas at the missions, but they will collect data only for the Big Idea on which they are working. The post-visit activities will be conducted both by teams and class.

Plan 2: The class will go through the Big Ideas together and collect each type of data at the missions.

Plan 3: The class chooses and works on questions from only one or two Big Ideas.

Resources:

Gartrell, J. E. Jr., Crowder, J., and J. C. Callister. (1989). Building a model of a stream, pp.35-46. *Earth:The Water Planet.* Washington DC: NSTA.

---------How fast does soil absorb water? In: *Earth the Water Planet,* pp. 8-11, Washington DC: NSTA

Mitchell, M. K. and W. B. Stapp. (1992). *Field Manual for Water Quality Monitoring:An Environmental Education Program for Schools, sixth ed.,* pp.136-138. Dexter, MI: Thomson-Shore Printers.

Repine, T. and Rockey, D. (May 1997). Constructing Contours. *The Science Teacher,* 64: 5, pp.

Rock, R. (Feb 1, 1993). *Tiempo de la siembra...tiempo de la fruta: Planting and harvest time--A preliminary study in preparation for the proposed Spanish colonial demonstration farm.* San Antonio Missions National Historical Park.

Smith, R. L. (1990). *Student Resource Manual* to accompany *Ecology and Field Biology,* 4th ed., p. A-85. New York: Harper and Row.

USDA Soil Triangle

USGS Topographic Map. *Southton Quadrangle,* 7.5-minute Series.

Resources for Students:

Guerra, M. A. N. (1987). *The San Antonio River.* San Antonio Texas: Alamo Press.

National Park Service, US Department of the Interior. (1996). *San Antonio Missions: Official Map and Guide.*

Smith, R.L. (1990). *Student Resource Manual to Accompany Ecology and Field Biology,* 4th Ed., p. A-85. New York: Harper and Row.

Related Field Trips:

Children's Museum: model of an *acequia* with flowing water and gates and model of river system and aquifer.

Witte Museum, HEB Tree House: out-of-doors model of an acequia with gates, water wheels, and water returning to San Antonio River.

Related Internet URLs:

Finch, J. N. and A. D. Buckert. The University of Texas San Antonio New Media Lab. Ghosts of Highways Past. http://nmlabutsa.edu/projects/tquests/2831/etc/index.htm

Frkuska, J. Mendez, P., and Parlett, J. The University of Texas San Antonio New Media Lab. Mysteries of the Caminos Reales. http://nmlab.utsa.edu/projects/tquests/2832/index.htm

National Park Service. San Antonio Missions. http://www.nps.gov/saan

Repine, T. and Rockey, D. (May 1997).